Project Report

ETS-19

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Magnitudes of Stars on the S-20 System

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LEXINGTON, MASSACHUSETTS

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This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER

Raymond L. Loiselle

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY
LINCOLN LABORATORY

MAGNITUDES OF STARS ON THE S-20 SYSTEM

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Group 94

PROJECT REPORT ETS-19

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ABSTRACT

An S-20 magnitude system is defined, and a relation between it and B,V-photometry is established. A catalog of m_V, (B-V), and m_{20} for 323 stars is given.

I. INTRODUCTION

Several institutions, including Lincoln Laboratory, are currently involved in observational projects which utilize image intensifier tubes for the detection and measurement of point sources. A variety of instruments, such as vidicons and image disectors, follows the intensifier tubes, but all share the spectral sensitivity of the first photo-sensitive surface of the intensifier, usually the multialkali type designated S-20.

Supplementary to the imaging system, it is desirable to have a classical astronomical photometric system with a set of known stars which serve as the system's intensity standards. Such a system can aid in the calibration of the imaging system measurements, correction for the effects of the earth's atmosphere and evaluation of the effects of the sky background. The simplest system for accomplishing this is one having the same spectral sensitivity as the imaging system, in this case the unfiltered S-20 response. This Report presents observations made on such a system -- the 6"-photometer at the GEODSS ETS.

The purpose of this catalog is use by the ETS automatic extinction package.* Additional uses include use as a reference system for variable star observers or for comet watchers. The automatic extinction package provides real-time measurement of

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*J. M. Sorvari and C. E. Beane, "Automatic Real-Time Extinction Measurement," Project Report ETS-17, Lincoln Laboratory, M.I.T. (12 September 1977).

atmospheric extinction and night sky brightness; it requires a sequence of reference stars distributed over the whole sky.

Since no advantage accrues from having regions of star density much greater than the mean, and since such concentrations do take additional computer resources, a significant fraction of the candidate stars was rejected in order to smooth the distribution. The somewhat higher density of stars near the equator reflects the greater importance of extinction measurements in this "synchronous band" of the sky. Limits on the magnitudes included were chosen to provide sufficient accuracy, avoid the need for changing the measuring range of the electronics and to allow both star and sky measurements to be made with the same field stop (~2').

II. THE m_{20} SYSTEM

Observations at the ETS were made with an uncooled EMI 9785B photomultiplier tube, having an S-20 spectral response. The response to starlight was measured as anode current using a Pacific Photometric Industries Model 124 photometer. Magnitudes calculated from these measurements are designated by the symbol m_{20}.

The standard stars for the m_{20} system are listed in Table I. Observations of standard stars were made on nights of "photometric quality" over a wide range of zenith distance. This allowed mean corrections for atmospheric extinction to be applied to both standards and unknowns. Although nights of genuinely high photometric quality are very rare at the ETS, it was found possible to satisfactorily reduce most night's data by making two to three times the usual number of standard observations. Each night's data was then brought to the standard system through comparison of the standards. In each case a simple additive constant (*i.e.*, a zero-point drift) was found to be sufficient. The mean error of a single observation was $<0\overset{m}{.}03$.

A total of 21 stars, in addition to the standards, with known Johnson B and V magnitudes was observed. These stars had (B-V) colors ranging from $0\overset{m}{.}40$ to $0\overset{m}{.}91$. A linear least squares fit between the systems yields the relation

$$m_{20} = m_V - .38 + .61(B-V)$$

The value .38 is needed to fit the normalization at (B-V) = .62.

This was used instead of the usual astronomical normalization at (B-V) = .00 for two reasons. First, no stars as blue as (B-V) = .00 were observed, and second, because of the anticipated use of the m_{20} system at ETS, it is convenient to have m_V and m_{20} approximately equal for nearly solar colored objects. The mean deviation from the linear fit is $0\overset{m}{.}03$ and is apparently due entirely to observational uncertainty in m_{20}, m_V and (B-V).

TABLE I

STANDARD STARS FOR THE ETS M_{20} SYSTEM

STAR		m_{20}
HD 10307	BS 483	$4^{m}.94$
20630	κ Cet	4.87
34411	λ Aur	4.71
65228	11 Pup	4.25
86728	20 LMi	5.41
111812	31 Com	4.94
142373	χ Her	4.59
157214	72 Her	5.38
182835	ν Aql	4.67
193370	35 Cyg	5.21
220657	υ Peg	4.40

III. THE ETS m_{20} CATALOG

Ordinarily a catalog of magnitudes would be built up through observation of a large number of stars on several photometric nights each. However, a great saving in observing time may be realized at only a moderate cost in precision by applying the results of Section II to stars with B,V-photometry. This has been done to give the catalog of 323 stars listed in Table II.

In order that this list be most useful to the work at the ETS, the stars have been limited primarily to the following ranges: $\delta > -25^{\circ}$, $.4 < (B-V) < .9$, $3.5 < m_{20} < 6.0$. An attempt has been made to avoid star density varying strongly with right ascension. Of the 323 stars, 121 have $\delta > +10^{\circ}$, thus the mean separation of these stars is about 12°. For $-20^{\circ} < \delta < +10^{\circ}$, there are 175 stars for a mean separation of 8°.

The first two columns of Table II give the stars numbers from the General Catalog (GC) and Harvard Annals (HD). These are followed by right ascension (RA), annual variation in RA, declination (DEC), and annual variation in DEC, for 1978.0. Next come the Johnson V-magnitude (m_V), the color (B-V) and the S-20 magnitude (m_{20}). The last column contains a code with the following meanings:

0 - Star not observed at ETS; m_{20} is constructed from m_V and (B-V) as in Sec. II

1 - Star observed 1-3 times; m_{20} is mean of

observations and constructed magnitude

2 - Star observed ≥ 4 times; m_{20} is mean of observations

3 - Standard star; m_{20} is standard value

The estimated precision in m_{20} ranges from better than $0\overset{m}{.}01$ for the standard stars to $0\overset{m}{.}03$ for the constructed magnitudes.

Many of the stars listed are components of binary systems. In these cases the entire system is the intended object, and the numbers listed are for the combined light.

TABLE II

GC	HD	RA	ANV	DEC	ANV	m_V	B-V	m_{20}	Q
33334	224930	$00^h01^m00^s.8$	$3^s.1$	26°57'58"	19"	$5^m.75$	$^m.66$	$5^m.77$	0
88	123	05 05.9	3.1	58 18 52	20	5.98	.67	6.01	0
169	571	09 10.1	3.1	45 56 59	20	5.04	.40	4.90	1
190	693	10 08.6	3.1	-15 35 19	20	4.88	.49	4.80	0
425	1671	19 57.3	3.2	37 50 48	20	5.15	.43	5.03	0
486	2114	24 16.5	3.1	01 49 04	20	5.76	.86	5.90	0
696	3196	34 06.9	3.1	-03 42 50	20	5.20	.56	5.16	0
701	3229	34 24.9	3.1	-00 37 34	20	5.92	.44	5.81	0
759	3546	37 23.2	3.2	29 11 32	20	4.39	.87	4.54	0
778	3651	38 12.8	3.1	21 07 55	19	5.87	.85	6.01	0
959	4628	47 13.6	3.2	05 10 04	19	5.74	.89	5.90	0
968	4676	47 49.0	3.2	16 49 19	19	5.07	.51	5.00	0
1003	4813	49 01.3	3.0	-10 45 45	19	5.19	.51	5.12	0
1004	4775	49 22.2	3.6	64 07 42	20	5.39	.49	5.31	0
1410	6920	01 09 03.3	3.4	41 57 53	19	5.65	.60	5.64	0
1501	7476	13 41.6	3.1	-01 05 27	19	5.69	.43	5.57	0
1600	8036	18 40.8	3.1	-00 37 26	19	5.86	.64	5.87	0
1594	7927	18 40.9	3.8	58 06 59	19	4.99	.68	5.02	0
1817	9021	29 33.6	4.5	70 09 08	19	5.82	.47	5.73	0
1888	9562	32 36.4	3.0	-07 08 14	18	5.74	.65	5.76	0
2050	10307	40 26.3	3.7	42 30 15	18	4.97	.61	4.94	3
2080	10476	41 17.9	3.3	20 09 44	18	5.23	.83	5.36	0
2123	10700	43 02.8	2.8	-16 03 08	19	3.50	.72	3.56	0
2161	10780	46 07.9	4.3	63 44 42	18	5.62	.81	5.73	0
2416	12235	59 00.3	3.1	02 59 34	17	5.87	.62	5.87	0

TABLE II (continued)

GC	HD	RA	ANV	DEC	ANV	m_V	B-V	m_{20}	Q
2488	12641	$02^h02^m40^s.4$	$3^s.1$	$-00^\circ26'41''$	17"	$6^m.00$	$^m.88$	$6^m.16$	0
2549	12953	07 07.2	4.2	58 19 12	17	5.68	.62	5.68	0
2619	13421	10 11.3	3.2	08 28 05	17	5.62	.56	5.58	0
2623	13456	10 17.3	2.9	-10 09 14	17	6.00	.40	5.86	0
2652	13612	11 39.8	3.1	-02 29 45	17	5.50	.58	5.47	0
2656	13611	11 49.8	3.2	08 44 40	17	4.37	.88	4.53	1
2707	13871	14 30.2	3.4	25 40 55	17	5.79	.44	5.68	0
2733	13974	15 42.1	3.7	34 07 30	17	4.87	.61	4.86	0
2770	14214	16 52.8	3.1	01 39 17	17	5.57	.61	5.56	0
2862	14802	21 32.2	2.8	-23 54 58	16	5.19	.60	5.18	0
3045	15798	31 02.5	2.8	-15 20 25	16	4.75	.45	4.64	0
3117	16161	34 43.0	3.2	05 29 54	16	4.86	.87	5.01	0
3116	15920	35 53.7	5.7	72 43 25	16	5.16	.88	5.32	0
3199	16620	38 29.8	2.9	-11 57 52	15	4.84	.44	4.73	0
3216	16673	39 08.1	2.9	-09 32 46	15	5.77	.52	5.71	0
3235	16765	40 06.1	3.1	-00 47 18	15	5.70	.52	5.64	0
3245	16739	40 51.1	3.8	40 06 07	15	4.92	.59	4.86	1
3277	16895	42 41.1	4.1	49 08 12	15	4.11	.49	4.03	0
3318	17206	44 04.5	2.8	-18 39 53	15	4.47	.47	4.38	0
3531	18262	55 03.0	3.2	08 17 40	15	5.96	.48	5.87	0
3562	18404	56 49.5	3.4	20 34 53	14	5.80	.41	5.67	0
3603	18692	58 37.9	2.6	-25 21 42	14	5.70	.41	5.57	0
3838	19994	03 11 38.9	3.1	-01 16 37	14	5.06	.59	5.04	0
3969	20630	18 12.3	3.2	03 17 27	13	4.84	.69	4.87	3
3970	20618	18 36.5	3.6	26 59 34	13	5.90	.86	6.04	0

TABLE II (continued)

GC	HD	RA	ANV	DEC	ANV	m_V	B-V	m_{20}	Q
4070	21120	$03^h23^m37^s.5$	$3^s.2$	08°57'11"	13"	$3^m.59$	$^m.89$	$3^m.75$	0
4140	21389	28 08.3	4.8	58 48 16	13	4.55	.56	4.51	0
4210	21770	30 54.3	4.2	45 59 03	12	5.31	.40	5.17	0
4244	22049	31 53.6	2.8	-09 31 53	12	3.72	.89	3.88	0
4313	22484	35 44.8	3.1	00 19 59	11	4.28	.57	4.23	1
4547	23754	45 53.9	2.6	-23 18 49	11	4.22	.43	4.10	0
4706	24554	53 11.0	3.0	-03 01 07	11	4.46	.68	4.49	0
4851	25457	04 01 29.0	3.1	-00 19 38	10	5.38	.51	5.31	0
4892	25621	03 00.7	3.1	02 46 07	10	5.35	.50	5.28	0
4913	25680	04 01.8	3.6	21 57 04	10	5.95	.62	5.95	0
4894	25007	06 13.7	10.0	80 38 33	10	5.10	.56	5.06	0
4973	25998	07 08.2	4.0	37 59 02	9	5.52	.54	5.47	0
5100	26722	12 44.3	3.3	09 12 34	9	4.83	.80	4.92	1
5138	26965	14 15.5	2.8	-07 41 09	6	4.43	.81	4.54	0
5199	27022	18 35.1	5.7	65 05 22	9	5.28	.82	5.40	0
5259	27497	19 30.7	3.2	06 04 48	9	5.76	.92	5.94	0
5433	28307	27 18.9	3.4	15 54 54	8	3.85	.94	4.04	0
5635	29391	36 29.6	3.0	-02 30 57	7	5.21	.29	5.01	0
5759	30020	42 31.5	2.9	-08 50 07	6	5.98	.64	5.99	0
5843	30495	46 36.8	2.7	-16 58 23	7	5.49	.63	5.49	0
5860	30562	47 31.2	3.0	-05 42 35	6	5.77	.64	5.78	0
6082	31925	58 02.0	2.7	-16 24 31	6	5.66	.46	5.56	0
6136	31910	05 01 27.1	5.3	60 24 47	5	4.04	.90	4.21	0
6255	32923	06 08.9	3.6	18 37 01	5	4.90	.65	4.92	0
6268	33093	06 23.3	2.8	-12 31 03	5	5.96	.60	5.95	0

TABLE II (continued)

GC	HD	RA	ANV	DEC	ANV	m_V	B-V	m_{20}	Q
6292	33256	$05^h07^m38^s.1$	$3^s.0$	$-04^\circ28'59''$	5"	$5^m.12$	$^m.44$	$5^m.01$	0
6361	33646	10 37.1	3.1	01 00 40	4	5.88	.66	5.90	0
6494	34411	17 35.4	4.2	40 04 55	3	4.70	.60	4.71	3
6511	34721	17 51.7	2.7	-18 09 09	4	5.95	.58	5.92	0
6509	34658	18 02.2	3.1	02 34 28	4	5.34	.41	5.21	0
6455	33564	18 53.9	9.9	79 12 38	4	5.05	.47	4.96	0
6596	35162	20 51.9	2.5	-24 47 35	4	5.06	.67	5.09	0
6700	35736	25 02.6	2.6	-19 42 49	3	5.64	.45	5.53	0
7002	37269	37 13.1	3.9	30 28 52	2	5.40	.45	5.29	0
7151	38089	41 49.6	2.9	-06 48 19	2	5.97	.44	5.86	0
7226	38529	45 26.9	3.1	01 09 42	1	5.94	.78	6.04	0
7228	28527	45 39.5	3.3	09 30 56	1	5.78	.88	5.94	0
7286	38858	47 29.2	3.0	-04 05 56	1	5.96	.64	5.97	0
7315	39070	48 36.5	2.7	-14 29 18	1	5.48	.88	5.64	0
7676	41116	06 02 47.0	3.7	23 15 58	0	4.15	.87	4.28	1
7849	42443	08 52.5	2.5	-22 46 09	-01	5.70	.43	5.58	0
8001	43318	14 27.0	3.1	-00 30 09	-01	5.63	.50	5.56	0
8033	43386	15 12.5	3.4	12 16 48	-01	5.04	.42	4.92	0
8058	43587	16 06.1	3.2	05 06 31	-01	5.70	.60	5.69	0
8151	43905	19 59.1	4.9	53 27 53	-02	5.36	.43	5.24	0
8298	45067	24 09.0	3.1	-00 55 52	-02	5.87	.56	5.83	0
8614	47138	35 25.0	2.6	-18 38 27	-03	5.52	.76	5.60	0
8711	46588	42 31.1	10.2	79 35 37	-04	5.47	.49	5.39	0
8954	49933	49 42.4	3.1	-00 30 46	-04	5.77	.40	5.63	0
9064	50692	53 57.5	3.7	25 24 18	-05	5.74	.57	5.71	0

TABLE II (continued)

GC	HD	RA	ANV	DEC	ANV	m_V	B-V	m_{20}	Q
9082	50522	$06^h55^m22\overset{s}{.}8$	$5\overset{s}{.}2$	58°27'15"	-05"	$4\overset{m}{.}35$	$\overset{m}{.}85$	$4\overset{m}{.}47$	1
9606	55575	07 14 12.5	4.5	47 16 52	-06	5.58	.58	5.55	0
9752	57006	18 36.6	3.2	07 11 06	-07	5.90	.53	5.84	0
9923	58526	24 46.3	3.0	-05 43 47	-07	5.97	.92	6.15	0
9957	58728	26 26.1	3.6	21 29 30	-07	5.25	.46	5.15	0
9979	59067	26 49.6	2.8	-11 30 39	-07	5.78	.58	5.75	0
10090	59984	31 02.5	2.9	-08 49 54	-08	5.89	.54	5.84	0
10134	60532	33 06.7	2.6	-22 14 51	-08	4.45	.54	4.40	0
10194	60803	35 24.3	3.2	05 54 42	-08	5.90	.60	5.89	0
10217	61064	36 10.9	3.0	-04 03 37	-08	5.13	.44	5.02	0
10257	61110	37 44.1	3.9	34 38 11	-08	4.92	.40	4.78	1
10629	64096	50 45.2	2.8	-13 50 20	-10	5.18	.59	5.16	0
10649	64235	51 42.6	3.0	-05 22 11	-09	5.75	.42	5.63	0
10756	65228	55 54.7	2.6	-22 49 13	-10	4.20	.72	4.25	3
10776	65345	57 12.2	3.1	02 17 05	-10	5.29	.93	5.48	0
11118	68146	08 09 38.6	2.8	-13 44 00	-11	5.53	.49	5.45	0
11138	68312	10 28.8	2.9	-07 42 20	-11	5.35	.88	5.51	0
11142	68256	10 57.5	3.4	17 42 56	-11	5.05	.54	5.00	0
11325	69830	17 21.3	2.9	-12 33 23	-12	5.96	.75	6.04	0
11348	69897	18 43.7	3.6	27 17 24	-12	5.13	.46	5.02	1
11393	70442	20 22.4	2.7	-20 00 30	-12	5.56	.78	5.66	0
11479	70958	23 29.2	3.0	-03 40 44	-12	5.60	.46	5.50	0
11600	71766	27 47.3	2.9	-09 40 26	-12	5.99	.43	5.87	0
11781	72945	34 40.9	3.2	06 41 51	-13	5.61	.55	5.57	0
11817	72905	37 15.9	5.3	65 05 58	-12	5.62	.61	5.61	0

TABLE II (continued)

GC	HD	RA	ANV	DEC	ANV	m_V	B-V	m_{20}	Q
11877	73752	$08^h38^m10^s.2$	$2^s.6$	$-22^\circ35'09''$	$-12''$	$5^m.05$	$^m.73$	$5^m.12$	0
12006	74395	42 35.7	3.0	-07 09 13	-13	4.62	.84	4.75	0
12091	74918	45 20.0	2.8	-13 28 00	-13	4.31	.90	4.48	0
12307	76151	53 13.0	3.0	-05 21 00	-14	5.99	.66	6.01	0
12415	76932	57 42.1	2.8	-16 02 51	-14	5.83	.53	5.77	0
12434	76943	59 13.0	3.9	41 52 16	-14	3.96	.44	3.85	0
12615	78418	09 07 29.9	3.5	26 43 17	-15	5.99	.66	6.01	0
12867	80499	18 42.8	2.9	-11 52 53	-15	4.78	.93	4.97	0
13048	81809	26 41.4	3.0	-05 58 27	-16	5.36	.64	5.37	0
13062	81858	27 16.8	3.2	09 09 12	-16	5.40	.60	5.39	0
13171	82210	32 34.3	5.3	69 55 44	-16	4.56	.77	4.72	1
13203	82635	32 52.8	3.7	36 29 46	-16	4.55	.92	4.73	0
13394	84117	41 14.8	2.7	-23 49 00	-16	4.93	.53	4.87	0
13497	84737	47 10.9	3.9	46 07 28	-17	5.09	.61	5.08	0
13570	85444	50 25.2	2.9	-14 44 33	-17	4.10	.93	4.29	0
13763	86728	59 44.9	3.5	32 01 57	-18	5.36	.65	5.41	3
14170	89449	10 18 32.3	3.3	19 34 59	-18	4.80	.45	4.69	0
14367	90089	28 34.1	7.3	82 40 20	-18	5.26	.37	5.11	0
14427	90839	29 14.0	3.8	56 05 38	-19	4.83	.52	4.77	0
14533	91612	33 39.2	3.1	07 04 04	-19	5.07	.94	5.26	0
14582	91889	35 26.6	3.0	-12 06 40	-19	5.68	.53	5.62	0
14624	92125	37 29.3	3.4	32 05 27	-19	4.70	.81	4.83	2
14631	92214	37 30.5	2.9	-16 45 43	-19	4.90	.92	5.08	0
14971	94388	52 24.9	2.9	-20 01 12	-19	5.24	.47	5.15	0
14994	94481	53 12.1	3.0	-13 38 27	-19	5.65	.83	5.78	0

TABLE II (continued)

GC	HD	RA	ANV	DEC	ANV	m_V	B-V	m_{20}	Q
15022	94672	$10^h54^m34^s.6$	$3^s.1$	00°51'16"	-19"	$5^m.90$	$^m.43$	$5^m.78$	0
15087	95128	58 14.5	3.4	40 32 54	-19	5.05	.61	5.04	0
15235	96097	11 03 52.8	3.1	07 27 18	-20	4.63	.34	4.46	0
15537	98230	17 00.8	3.2	31 39 11	-20	3.79	.59	3.82	2
15644	98991	22 16.4	3.0	-18 39 32	-20	5.09	.43	4.97	0
15652	99028	22 46.8	3.1	10 39 03	-20	3.95	.41	3.82	0
15714	99564	26 02.8	3.0	-12 14 08	-20	5.93	.49	5.85	0
15768	99922	28 32.6	3.0	-24 20 31	-20	5.75	.70	5.80	0
15822	100203	31 06.9	3.4	61 12 18	-20	5.48	.50	5.41	0
15867	100563	33 14.4	3.1	03 10 57	-20	5.76	.47	5.67	0
15977	101198	37 32.9	3.1	-13 04 49	-20	5.48	.52	5.42	0
16173	102509	46 51.0	3.1	20 20 28	-20	4.54	.55	4.50	0
16215	102870	49 33.0	3.1	01 53 19	-20	3.59	.56	3.55	2
16286	103462	53 34.9	3.1	-25 35 32	-20	5.30	.88	5.46	0
16421	104304	59 36.6	3.1	-10 19 14	-21	5.55	.77	5.64	0
16616	105702	12 08 56.2	3.1	05 55 46	-20	5.72	.36	5.56	0
16822	107295	19 02.2	3.1	-22 03 12	-20	5.96	.82	6.08	0
16873	107700	21 24.2	3.0	25 58 04	-20	4.82	.50	4.75	0
16906	107950	22 57.6	2.9	51 41 03	-20	4.80	.87	4.92	2
17087	109085	30 55.9	3.1	-16 04 27	-20	4.31	.38	4.16	0
17127	109358	32 42.1	2.9	41 28 35	-20	4.27	.59	4.25	0
17180	109704	35 39.2	3.1	-05 42 38	-20	5.86	.70	5.91	0
17259	110317	40 07.5	3.1	-12 53 39	-20	5.27	.42	5.15	0
17309	110646	42 30.0	3.1	-01 27 23	-20	5.96	.83	6.09	0
17404	111456	47 42.4	2.6	60 26 23	-20	5.85	.47	5.76	0

TABLE II (continued)

GC	HD	RA	ANV	DEC	ANV	m_V	B−V	m_{20}	Q
17455	111812	$12^h50^m37^s.7$	$2^s.9$	27°39'35"	-20"	$4^m.94$	$.^m68$	$4^m.94$	3
17711	113415	13 02 35.0	3.2	-20 27 55	-19	5.57	.56	5.53	0
17833	114378	08 55.1	2.9	17 38 44	-19	4.32	.46	4.22	0
17870	114642	10 52.9	3.2	-16 04 49	-19	5.04	.46	4.94	0
17975	115383	15 40.9	3.0	09 32 19	-19	5.22	.58	5.19	0
18007	115617	17 15.0	3.1	-18 11 22	-20	4.75	.71	4.80	0
18135	116568	23 24.3	3.1	-05 02 58	-19	5.75	.42	5.63	0
18212	117176	27 21.0	2.9	13 53 45	-19	4.97	.71	5.01	2
18359	118216	33 48.9	2.7	37 17 41	-18	4.98	.39	4.84	0
18366	118219	34 22.4	3.1	-05 17 04	-18	5.72	.95	5.92	0
18568	119605	43 18.4	3.2	-16 04 09	-18	5.58	.80	5.69	0
19041	123255	14 05 32.7	3.2	-09 12 35	-17	5.45	.35	5.28	0
19127	123999	09 23.8	2.7	25 11 41	-17	4.83	.54	4.75	2
19188	124425	12 32.4	3.1	-00 44 34	-17	5.90	.48	5.81	0
19244	124850	14 51.5	3.2	-05 53 48	-17	4.08	.51	4.01	0
19303	125276	17 45.4	3.4	-25 43 03	-16	5.86	.50	5.79	0
19319	125451	18 12.2	2.9	13 06 17	-17	5.40	.37	5.25	0
19467	126660	24 26.7	2.0	51 57 07	-17	4.05	.49	3.97	0
19504	126868	27 03.9	3.1	-02 07 49	-16	4.80	.70	4.85	0
19816	129502	41 53.8	3.2	-05 33 51	-16	3.88	.38	3.73	0
19970	130819	49 28.0	3.3	-15 54 26	-15	5.16	.40	5.02	0
20342	134083	15 06 20.1	2.6	24 57 14	-14	4.93	.43	4.83	2
20532	136064	14 22.6	0.7	67 25 50	-14	5.14	.53	5.08	0
20591	136202	18 11.1	3.1	01 50 51	-14	5.05	.53	4.99	0
20696	137107	22 17.7	2.5	30 21 58	-13	4.97	.58	4.94	0

TABLE II (continued)

GC	HD	RA	ANV	DEC	ANV	m_V	B-V	m_{20}	Q
20699	137052	$15^h23^m00^s.0$	$3^s.3$	$-10^\circ14'39''$	$-13''$	$4^m.93$	$^m.45$	$4^m.82$	0
21029	139460	37 28.6	3.3	-08 43 18	-11	5.78	.50	5.71	0
21031	139446	37 38.1	3.5	-19 13 53	-12	5.38	.86	5.52	0
21155	140538	42 55.3	3.0	02 35 05	-12	5.87	.69	5.91	0
21201	141004	45 22.3	2.9	07 25 14	-11	4.43	.60	4.42	0
21340	142373	51 54.7	2.1	42 30 43	-10	4.63	.58	4.59	3
21408	142860	55 26.1	2.8	15 43 54	-12	3.85	.48	3.76	0
21495	143333	59 05.4	3.4	-16 28 13	-11	5.46	.52	5.40	0
21527	143761	16 00 11.9	2.3	33 22 07	-11	5.41	.61	5.40	0
21572	144284	01 28.3	1.1	58 37 24	-10	4.06	.51	3.98	2
21593	144069	03 09.3	3.3	-11 18 50	-10	4.16	.45	4.05	0
21659	144608	06 06.7	3.5	-20 48 39	-10	4.32	.84	4.45	0
21864	146233	14 25.3	3.3	-08 18 46	-10	5.50	.65	5.52	0
21969	147084	19 18.5	3.6	-24 07 06	-09	4.54	.84	4.67	0
22200	148786	29 52.4	3.4	-16 33 57	-08	4.28	.92	4.46	0
22321	149661	35 11.9	3.2	-02 16 46	-08	5.76	.83	5.89	0
22460	150557	40 35.5	3.0	01 13 17	-07	5.72	.32	5.54	0
22502	150997	42 08.5	2.1	38 57 48	-07	3.53	.92	3.71	0
22643	151769	48 36.9	3.3	-10 44 46	-06	4.65	.47	4.56	0
22871	153597	55 54.0	0.3	65 10 05	-06	4.91	.47	4.81	2
23092	154905	17 04 52.1	1.2	54 29 56	-05	4.92	.48	4.83	0
23274	155885	13 59.5	3.7	-26 34 21	-05	4.32	.85	4.46	0
23423	156897	19 41.1	3.6	-21 05 29	-04	4.40	.39	4.26	0
23446	157214	19 49.9	2.2	32 29 42	-05	5.40	.62	5.38	3
23614	157978	25 15.3	2.9	07 36 46	-03	6.05	.58	6.02	0

TABLE II (continued)

GC	HD	RA	ANV	DEC	ANV	m_V	B-V	m_{20}	Q
23617	157950	$17^h 25^m 27^s.6$	$3^s.2$	$-05^\circ 04' 09''$	-03"	$4^m.53$	$.^m39$	$4^m.39$	0
23706	168614	29 15.8	3.1	-01 02 46	-03	5.31	.73	5.38	0
23732	158837	30 15.1	3.0	02 44 21	-03	5.58	.84	5.71	0
24343	163989	50 25.7	-2.7	76 58 01	-01	5.01	.50	4.94	0
24320	162917	52 09.8	2.9	06 06 16	-01	5.76	.42	5.64	0
24503	164259	59 19.2	3.2	-03 41 25	00	4.62	.38	4.47	0
24538	164668	18 00 33.7	2.5	21 35 39	00	4.28	.38	4.13	0
24555	164584	01 30.2	3.7	-24 17 02	00	5.35	.52	5.29	0
24565	164764	01 53.1	3.3	-08 10 55	00	4.78	.39	4.64	0
24641	165341	04 20.4	3.0	02 30 12	-01	4.05	.84	4.19	2
24700	165908	06 11.3	2.3	30 33 27	01	5.05	.52	4.99	0
24724	166208	06 49.0	1.8	43 27 30	01	4.99	.91	5.16	0
24916	168151	13 46.3	0.4	64 23 22	01	5.02	.38	4.87	0
25036	168656	19 45.9	3.0	03 21 56	02	4.84	.91	5.00	2
25153	169689	24 35.3	2.9	08 01 05	02	5.64	.91	5.82	0
25176	169985	26 04.9	3.1	00 10 52	02	5.21	.49	5.13	0
25362	171635	32 11.5	1.0	57 01 42	03	4.77	.61	4.76	0
25374	171391	33 48.8	3.3	-10 59 47	03	5.13	.92	5.31	0
25427	171834	35 34.9	2.9	06 39 09	03	5.44	.38	5.29	0
25846	174464	49 45.8	3.3	-09 48 04	04	5.82	.61	5.81	0
25935	175535	52 40.9	1.5	50 40 48	05	4.91	.90	5.08	0
25954	175492	53 49.0	2.5	22 36 59	05	4.59	.79	4.70	1
26030	176051	56 12.0	2.3	32 52 19	05	5.22	.60	5.21	0
26075	176303	58 04.8	2.8	13 35 30	05	5.26	.53	5.20	0
26379	178596	19 07 55.2	2.9	06 02 15	06	5.22	.35	5.05	0

TABLE II (continued)

GC	HD	RA	ANV	DEC	ANV	m_V	B-V	m_{20}	Q
26516	179950	$19^h14^m11^s.5$	$3^s.7$	$-25^\circ 17' 47''$	06"	$4^m.85$	$^m.57$	$4^m.82$	0
26669	181391	19 22.3	3.2	-05 27 31	07	5.00	.92	5.18	0
26838	182835	25 23.6	3.1	00 17 37	07	4.67	.60	4.67	3
27050	185144	32 24.2	-0.1	69 37 25	06	4.69	.79	4.79	0
27141	185395	35 51.1	1.6	50 10 08	08	4.49	.38	4.34	0
27143	185124	36 37.1	3.2	-04 41 54	08	5.45	.43	5.33	0
27249	186155	40 09.4	1.9	45 28 17	09	5.06	.41	4.93	0
27255	186005	41 15.6	3.4	-16 10 39	08	5.05	.34	4.88	0
27349	186648	45 04.8	3.5	-19 48 55	09	4.86	.93	5.05	0
27369	187013	45 35.4	2.3	33 40 32	08	4.98	.47	4.89	0
27480	187691	49 58.3	2.9	10 21 33	09	5.13	.55	5.09	0
27516	187982	51 05.9	2.5	24 56 06	09	5.55	.70	5.60	0
27587	188512	54 14.0	3.0	06 21 02	09	3.71	.86	3.85	0
27583	188376	54 29.5	3.7	-26 21 36	10	4.70	.76	4.78	0
27689	189340	58 35.5	3.3	-10 01 02	09	5.88	.58	5.85	0
27835	190406	20 03 06.6	2.7	17 00 32	10	5.78	.60	5.77	0
28071	192455	11 13.3	1.0	62 00 41	11	5.75	.47	5.66	0
28174	192985	15 17.6	1.9	45 30 39	11	5.90	.35	5.73	0
28200	192947	16 50.1	3.3	-12 36 51	11	3.56	.94	3.75	0
28242	193370	17 48.2	2.3	34 54 47	11	5.16	.65	5.21	3
28481	194943	27 36.4	3.4	-17 53 17	12	4.78	.37	4.63	0
28563	195564	31 11.4	3.3	-09 55 47	12	5.65	.69	5.69	0
28725	196574	37 12.1	3.1	-01 10 59	13	4.31	.95	4.51	0
28756	196755	38 03.5	2.9	10 00 28	13	5.06	.71	5.11	0
28929	197692	44 47.7	3.6	-25 21 06	13	4.14	.43	4.02	0

TABLE II (continued)

GC	HD	RA	ANV	DEC	ANV	m_V	B-V	m_{20}	Q
28956	198084	$20^h44^m48^s.4$	$1^s.5$	57°30'00"	13"	$4^m.52$	$^m.54$	$4^m.49$	1
28965	197963	45 37.3	2.8	16 02 39	13	3.90	.84	4.03	0
29078	198571	50 15.7	3.2	-05 42 35	14	5.98	.46	5.88	0
29112	198809	51 11.1	2.6	27 00 50	14	4.57	.84	4.70	0
29109	198743	51 28.2	3.2	-09 04 02	14	4.72	.33	4.54	0
29276	199766	57 58.5	3.0	04 12 28	14	5.22	.46	5.12	0
29417	200496	21 02 54.8	3.2	-05 54 40	14	5.53	.68	5.56	0
29571	201381	08 23.9	3.3	-11 27 42	15	4.51	.94	4.70	0
29697	202275	13 24.5	2.9	09 55 01	15	4.46	.52	4.42	1
29723	202444	13 54.8	2.4	37 57 03	15	3.73	.38	3.58	0
29735	202447	14 43.4	3.0	05 09 21	15	3.91	.53	3.85	0
29877	203222	19 54.9	3.1	-04 39 16	15	5.86	.92	6.04	0
29903	203387	21 01.4	3.3	-16 55 47	15	4.28	.90	4.45	0
29957	203705	22 59.4	3.3	-12 58 26	15	5.48	.30	5.28	0
30059	204381	27 28.3	3.4	-21 54 14	16	4.50	.90	4.67	0
30207	205435	33 09.1	2.3	45 29 37	16	4.02	.90	4.19	0
30354	206301	40 21.1	3.3	-14 08 47	16	5.18	.65	5.20	0
30382	206453	41 25.9	3.4	-18 58 04	16	4.72	.88	4.88	0
30437	206826	43 09.2	2.7	28 38 34	16	4.51	.49	4.44	1
30483	207260	44 48.7	1.7	61 01 07	17	4.28	.51	4.21	0
30631	207958	52 05.9	3.3	-13 39 24	17	5.07	.38	4.92	0
30800	209369	58 56.7	0.9	73 04 29	17	5.03	.44	4.92	0
31016	210459	22 09 00.3	2.7	33 04 12	18	4.27	.48	4.20	1
31163	211434	15 57.5	3.1	-05 29 51	18	5.74	.88	5.90	0
31398	213051	27 41.7	3.1	-00 08 00	18	3.65	.40	3.51	0

TABLE II (continued)

GC	HD	RA	ANV	DEC	ANV	m_V	B-V	m_{20}	Q
31425	213235	$22^h28^m51\overset{s}{.}0$	$3\overset{s}{.}0$	04°19'09"	18"	$5\overset{m}{.}48$	$\overset{m}{.}39$	$5\overset{m}{.}34$	0
31516	213845	33 29.5	3.3	-20 49 19	18	5.20	.44	5.09	0
31778	215648	45 35.6	3.0	12 03 35	19	4.19	.51	4.07	1
31884	216380	50 30.6	2.3	61 34 45	19	5.60	.79	5.70	0
31899	216385	51 17.0	3.0	09 43 07	19	5.16	.47	5.07	0
31960	216718	54 02.5	3.1	-05 06 19	19	5.71	.88	5.87	0
32003	217014	56 22.9	3.0	20 39 01	19	5.48	.67	5.51	0
32237	218658	23 07 11.5	1.9	75 16 07	20	4.41	.78	4.51	0
32233	218527	07 33.2	3.1	02 00 28	20	5.39	.91	5.57	0
32262	218640	08 44.4	3.2	-22 34 38	20	4.69	.66	4.71	0
32288	218804	09 25.8	2.8	43 25 31	19	5.95	.44	5.84	0
32462	219834	17 57.1	3.2	-13 34 43	20	5.07	.80	5.18	0
32468	219877	18 15.5	3.1	-05 14 40	20	5.55	.40	5.41	0
32585	220657	24 16.5	3.0	23 16 57	20	4.44	.61	4.40	3
32667	221115	28 02.2	3.0	12 38 21	20	4.53	.94	4.72	0
32774	221675	33 00.9	3.1	-01 22 09	20	5.86	.31	5.67	0
32818	221950	35 15.8	3.1	01 58 48	20	5.66	.44	5.55	0
32879	222368	38 49.1	3.1	05 30 24	20	4.13	.51	4.06	0
32911	222574	40 37.2	3.1	-17 56 18	20	4.82	.82	4.94	0
33029	223252	46 48.4	3.1	-02 53 03	20	5.48	.94	5.67	0
33051	223385	47 45.1	2.9	62 05 32	20	5.42	.66	5.44	0
33248	224533	57 32.7	3.1	-03 40 40	20	4.86	.93	5.05	0
33262	224617	58 10.7	3.1	06 44 28	20	4.02	.41	3.89	0

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An S-20 magnitude system is defined, and a relation between it and B, V-photometry is established. A catalog of m_V, (B-V), and m_{20} for 323 stars is given.